pioneers being *Calamovilfa longifolia*, *Psoralea lanceolata*, and *Redfieldia flexuosa*. After a time these pioneers are followed by the bunch-brass association; after this vegetational changes are much less rapid. One of the chief features of interest in the woodland formations along the streams is the overlap of the deciduous eastern forest and the yellow pine (*Pinus ponderosa scopulorum*) forest of the west. The lowland formations are much like those elsewhere both as to content and succession, except that a meadow type represents the temporary climax; probably one of the more eastern of the prairie-grass associations represents a more ultimate condition.—H. C. COWLES.

The water-balance of desert succulents.—The Sonoran desert is very rich in succulents which carry a large water-balance. Some of the most striking of these have been studied in detail for some years at the Desert Laboratory.[7] Mrs. SPALDING had previously shown that the stems of *Cereus giganteus* expand and contract in a most remarkable manner, as water is accumulated or lost.[8] These movements are readily measured by noting the variations in distance between the ridges from time to time. Mrs. SPALDING, as her part of the contribution, reports greatly extended experiments along this line on the same and on additional species. The earlier work has been confirmed in practically all respects. In addition to the influence of soil water in changing the plant form, insolation is found to be an important secondary factor; for example, the furrows on the south sides of stems are narrower than those on the north sides. The behavior of *Echinocactus Wislizeni* is much like that of *Cereus giganteus*, but in *Opuntia* the behavior is simpler, consisting merely of the swelling and shrinking of the stem segments.

MACDOUGAL'S part of the work consisted of a study of variations in the water-balance, due to seasonal moisture fluctuations and other causes. The remarkable ability of these desert succulents to tide over long periods of drought is brought out in striking fashion in the case of plants of *Cereus giganteus*, in which branches have remained alive and even have bloomed a year after the main trunk bearing them has died. More efficient even than the cacti is *Ibervillea sonorae*, a plant whose stem base is tuberized. For ten years tubers of this species have remained alive, without a renewal of water supply, sending up short green stems each summer; during this time but half of the original weight had been lost. In the general conclusions attention is called to great differences in individual behavior under similar experimental conditions. The

[7] MACDOUGAL, D. T., and SPALDING, E. S., The water-balance of succulent plants. Carnegie Institution of Washington, Publication 141. *pp.* 77. *pls.* 8. 1910. See also MACDOUGAL, D. T., The water-balance of desert plants. Ann. Botany **26**:71–93. *pls.* 5. 1912.

[8] SPALDING, E. S., Mechanical adjustment of the Sahuaro (*Cereus giganteus*) to varying amounts of stored water. Bull. Torr. Bot. Club **32**:57–68. 1905; see BOT. GAZ. **40**:396. 1905.

decline in evaporation each year in plants whose water supply is not replenished is attributed in part to increasing concentration of the cell sap; in the cacti this increase was from 1 to 3 per cent. From 60 to 70 per cent of the maximum water-balance may be lost by cacti without impairing the power of recovery and subsequent growth. It is suggested that a detailed chemical study of these plants is needed, it being felt that their high osmotic activity and their great acidity resulting from modified photosynthesis are insufficient to explain the origination of the habit of accumulating and retaining large water-balances.—H. C. COWLES.

English woodlands.—As would be expected, very few of the English woodlands are primeval. Such woodlands may still be found, however, near the upper forest limits in mountainous regions.[9] Most English woodlands are to be regarded as semi-natural, that is, the trees are felled somewhat regularly, but the reproduction, either from seeds or suckers, is natural. New forest plantations are distinguishable from natural or semi-natural woodlands by the presence at times of exotic tree species, and almost always by the absence of a representative woodland ground flora. Three main series of woodlands are recognized, the alder-willow series of wet soils, the oak-birch series of siliceous soils, and the beech-ash series of calcareous soils. The series are further divided into associations.

ADAMSON has made an intensive study of Gamlingay Wood in western Cambridgeshire, one of the semi-natural woodlands noted above.[10] The wood is on bowlder clay, part of which is calcareous and part non-calcareous; the trees on the former are oak and ash, while the ash is absent on the latter. Although it is noted that there are intergradations, it is observed that the herbage in the two woodland types is different; the dominant forms in the siliceous woodland are *Pteris aquilina* and *Holcus mollis*, whereas those of the calcareous woodland are *Spiraea Ulmaria*, *Mercurialis perennis*, *Deschampsia caespitosa*, and *Fragaria vesca*. Little attention is paid to successional features. It is believed by the reviewer that more thorough successional studies would tend to break down some of the distinction between calcareous and siliceous woodlands, as recognized by English ecologists; it seems almost certain that an original underlying soil must more and more lose its influence on vegetation, as humus accumulates. Careful studies were made by ADAMSON of evaporation, soil moisture, and other factors.

In connection with the above it may be noted that TANSLEY and ADAMSON[11] have given an account of some observations made in some Gloucestershire

[9] MOSS, C. E., RANKIN, W. M., and TANSLEY, A. G., The woodlands of England. New Phytol. **9**:113–149. 1910.

[10] ADAMSON, R. S., An ecological study of a Cambridgeshire woodland. Jour. Linn. Soc. Bot. **40**:339–387. *pls. 6*. 1912.

[11] TANSLEY, A. G., and ADAMSON, R. S., Reconnaissance in the Cotteswolds and the Forest of Dean. Jour. Ecol. **1**:81–89. 1913.